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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 539.

PROPAGATION OF CITRUS TREES IN THE GULF STATES.

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Director of the Agricultural Experiment Station of Florida.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., March 27, 1913.

SIR: Many requests are received at the United States Department of Agriculture for information on the methods employed in growing oranges and other citrus fruits in Florida and the other Gulf States, and it is important that the Department be able to supply the desired information as fully as possible. In order to furnish this information in concise form, Prof. P. H. Rolfs, Director of the Agricultural Experiment Station of Florida, has revised Farmers' Bulletin 238, entitled "Citrus Fruit Growing in the Gulf States," and has divided the material contained in that publication into three parts, of which this paper is the second, as follows: (1) "Sites, Soils, and Varieties for Citrus Fruit Growing in the Gulf States"; (2) "Propagation of Citrus Trees in the Gulf States"; and (3) "Culture, Fertilization, and Frost Protection of Citrus Groves in the Gulf States." In this form the information will be more available for distribution in the territory directly concerned and will be of more service, it is believed, to prospective citrus-fruit growers and to planters already engaged in this industry. I have the honor to recommend that the paper be published as a Farmers' Bulletin.

Respectfully,

WM. A. TAYLOR,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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B. P. I.—878.

PROPAGATION OF CITRUS TREES IN THE GULF STATES.

INTRODUCTION.

This bulletin is published to fulfill an urgent request from growers in the Gulf States for a brief description of the methods of propagating citrus trees and of the most important nursery practices. It includes also a discussion of the choice of suitable stocks for different regions. Because of the limited size of the publication and in order to make it applicable to Florida and the other Gulf States the questions have necessarily been treated in a very general manner.[1]

THE NURSERY.

The nursery is the starting point of the citrus grove. It is therefore one of the factors of greatest importance. No matter how well the climate may be suited to the growing of fruit or how well the grove may be cared for after it is planted, if improper selections have been made in the matter of stock or of buds, disappointment is just as certain as if improper selection had been made of the locality in which to grow the fruit.

SUITABLE STOCKS FOR DIFFERENT SECTIONS.

Each of the principal citrus-growing regions of the United States has a stock which is best adapted to its own peculiar conditions. Even in the larger citrus-growing regions the variations of soil are such as to demand different kinds of stocks or buds.

Louisiana and Mississippi.—In Louisiana and Mississippi the soil is a heavy clay, very fertile, and usually quite moist. *Citrus trifoliata*, or *trifoliata*, as it is commonly called, is preeminently the stock for use in this section. Here it not only is a vigorous grower but also imparts more or less of hardiness to the scion by becoming dormant in the autumn, since the *trifoliata* is a deciduous species (fig. 1).

[1] For discussions of other phases of this industry, see Farmers' Bulletins 538, entitled "Sites, Soils, and Varieties for Citrus Groves in the Gulf States"; 542, entitled "Culture, Fertilization, and Frost Protection of Citrus Groves in the Gulf States"; and 172, entitled "Scale Insects and Mites on Citrus Trees." A Farmers' Bulletin on the harvesting and marketing of citrus fruits is in preparation.

Eastern north Florida.—In the eastern part of north Florida the *trifoliata* is also the best stock to use, for the reason given in the preceding paragraph. Much of this region is also a rather heavy, sandy soil inclined to become clayey. In the deep, sandy portion of this section some of the more rampant-growing stocks do equally as well as or possibly better than the *trifoliata*, but they do not produce quite so hardy a tree.

Central Florida.—Throughout central Florida the soil is inclined to be sandy, but usually contains a considerable quantity of decaying vegetable matter. On this soil the pomelo stock does best, although it does not make quite so hardy a tree as the sour-orange stock.

FIG. 1.—Citrus nursery at Naomi, La.: Trifoliata stock and mandarins to right; pomelos to left. Buds of one summer's growth.

South Florida.—The rough lemon is preeminently the stock adapted for use in south Florida. It is a rampant grower, able to live on soils that are almost sterile for the other stocks mentioned, but is inclined to produce a little more coarse fruit than the other stocks. In the heavy soil of this section, especially that which is free from limestone, the pomelo and sour orange may be used to good advantage. These trees are somewhat slower in growth, but produce a more smooth and velvety fruit and ripen more evenly. The lime seedlings have also been used for stocks in this section. This makes a tree rather sensitive to cold, and the earliest crops of the fruit are inclined

to be somewhat rough and thick skinned. The greatest drawback, however, from the nurseryman's point of view, is that the ordinary operation that would make 90 per cent of the buds live in rough-lemon stock would probably not give more than 50 per cent in the lime stock. It is therefore used very little.

SELECTING SEEDS.

In selecting seeds from which to grow nursery stock, one should choose well-matured specimens. It is a matter of indifference as to the perfection or imperfection of the fruit from which the seed is taken, but the seed should be plump and well filled and the fruits taken from the most vigorous trees. This is true for all the varieties that are to be used as stock. One is frequently able to secure a lot of pomelo drops and culls and from these secure large numbers of fine seeds.

There are various methods of obtaining seeds from the fruit. Where fruit has been damaged and thrown out to rot, the seed may be washed out from the rotting mass and the superfluous water dried off. The seed may be separated fairly easily by using an ordinary sieve with large openings and forcing the water on the seed by the use of a force pump or from a tank.

After gathering these fruits they are cut into sections with a dull knife and most of the seeds pressed out, and the cut sections are thrown into a barrel and covered with water. In a short time this mass will be sufficiently disintegrated to allow easy separation of the remainder of the seed. Care must be taken, of course, not to let the material remain in the water long enough to injure the seed. If the barrel is placed in a warm location, in two or three days the seeds will slip out easily, and they can then be separated from the pulp by washing.

The seeds that are squeezed out by hand need no special washing. They should be placed in the open in a shed to allow the superfluous moisture to dry off and then are ready for preservation. Bonavia says that in India the seeds "are well dried in the sun for two or three days."

KEEPING SEEDS.

In the northern sections of the citrus-growing regions the seed must be kept for a considerable time before the ground is sufficiently warm to receive it. After the superfluous moisture has dried from the seeds, which will occur in the course of from one to three days, they may then be preserved in dry sand. Where sand is not readily obtained, a fairly dry clay, such as will break up readily but which is not moist enough to pack, will be found useful. In this kind of

material the seeds of *trifoliata* have been shipped from Japan to Florida and have retained their germinating qualities perfectly.

PREPARATION OF THE SEED BED.

Where only a few thousand seeds are to be planted they may be germinated in boxes or trays. Taking a box which is about 8 or 10 inches deep, with its other dimensions of convenient size, 3 or 4 inches of soil are placed in the bottom. The seed may then be sown on this layer of soil and an inch more of soil placed over them. Over this a layer of mulching, such as decayed leaves or sphagnum, or, in fact, anything that will keep the soil from drying out, may be placed, and in this the seed may be allowed to germinate and seedlings grown. The mulching should be removed as soon as the seedlings begin to come up.

The ordinary seed bed, or cold frame, as it is usually prepared by gardeners, is also an excellent place to germinate the seed and grow seedlings. In planting in beds of this kind the rows should be made 6 inches or a foot apart and the seeds dropped at the rate of one or two dozen to each foot of row. The seedlings may be left there until they have grown sufficiently large to be planted in the nursery.

For growing seedlings on a large scale, where hundreds of thousands are to be grown, it becomes necessary to make a careful selection of the spot where the seeds are to be planted. A place that is not in danger of being flooded or becoming too wet, and yet that will remain constantly moist, should be chosen. This land should be thoroughly broken up, plowed deep, especially if it is of a heavy or clayey nature, the rows laid off from 2 to 4 feet apart, according to conditions, and the rows then opened and a liberal application of fertilizer made. If the site happens to be a clay soil it is well to break the rows at least 10 inches deep. Fertilizer is then scattered down the rows and worked in thoroughly by the usual farming implements. From two weeks to a month after the seed bed has been prepared in this way the seed may be sown. The furrows are thrown open 5 inches deep and the seed scattered down the rows, being sufficiently distributed to give each seed an inch or so of space. The rows may be made from 4 to 8 inches wide, according to the needs and conditions. The seeds are then covered about an inch deep and the soil firmed about them. If drought follows the planting it may become necessary to resort to watering to keep the seed from drying out.

TIME OF SOWING.

The best time to sow depends upon the location of the seed bed. In southern Florida and the West Indies the seed may be sown as early as December. In central and northern Florida, and in Louisi-

ana, Mississippi, and California, it is better to wait until the soil has warmed up sufficiently to induce rapid germination and active growth. This time may be reached anywhere from the first of February until about the middle of March or later, varying in different seasons and in different localities.

CULTIVATION OF THE SEED BED.

The cultivation of the citrus seed bed is the same as that usually given to seeds of garden crops. At first a light working, such as may be done with a garden rake, will be most useful. A skillful laborer may rake over a seed bed when the seedlings are coming through the ground with entire safety to the small plants. This raking may seem quite useless in many instances, but it is very important in that it conserves the soil moisture and breaks the crust if there is any tendency to form a hard surface. The middles may be cultivated with the usual shallow-going farm tools—a spring-tooth cultivator, a special harrow, or a hand plow. Cultivation should be repeated every week or ten days, and as the seedlings grow stronger the cultivation in the clay soils should be made deeper, until in midsummer or early autumn it has reached the maximum depth of farm cultivation. On the sandy lands cultivation should never be more than 3 or 4 inches deep, for on such lands the soil is already sufficiently loose and further stirring does not add to its productiveness.

TRANSPLANTING.

Under favorable conditions the seedlings will have attained a height of from 6 to 12 inches and the diameter of a small pencil by autumn or by the next winter. The seedlings are then in good condition for transplanting. The best time for transplanting is less definite than that of sowing the seed. In the West Indies and southern Florida transplanting may be done with good success any time after the seedlings are of sufficient size, depending on the favorable condition of the soil. In other citrus-growing regions transplanting is done in the spring or early summer, whenever favorable climatic conditions occur. Under some conditions seedlings are permitted to remain in the seed bed for nearly two years.

In preparing for transplanting on a large scale the nurseryman frequently uses a tree digger to run under the seedlings. This loosens up the ground on both sides, and at the same time cuts most of the taproots. The depth to which the tree digger should be run will depend on the amount of root growth the seedlings have made. In heavy soils transplanting is much facilitated by plowing a deep furrow on each side of the seedling row. A heavy spade may then be inserted under the row, and the seedlings lifted without much dam-

age to the root system. Some means for keeping the roots moist after they have been removed from the ground should be provided.

PREPARATION FOR THE NURSERY.

The location of the nursery is of very considerable importance. The land selected can usually be slightly more moist than such as would ordinarily produce a good grove, but to be successful it should not be subject to flooding, nor should it be subject to drying out during severe droughts. The rows should be laid off from 4 to 6 feet apart, thoroughly broken out to a considerable depth, say about 10 inches, and then prepared in the usual manner in which gardeners prepare their land for vegetables.

Thoroughly rotted stable manure will be found an excellent fertilizer in heavy clay soils. In the soils that are inclined to be sandy, commercial fertilizers will be found of greater advantage. The quantity of manure and fertilizer to be used will depend on the fertility of the land to be planted. Upon the ordinary sandy soils from 500 to 1,000 pounds will be found entirely sufficient for the first application. On rich clay soils well-rotted stable manure at the rate of several loads to the acre will be found sufficient.

The rows should be prepared thoroughly and the land made ready about a month before the probable time for setting out the nursery stock. After the land has been prepared it will do no special harm if one has to wait longer than was expected before a favorable time for transplanting arrives.

When the time for transplanting arrives the seedlings may be taken out of the seed beds and transplanted into the nursery rows in various ways. The trees should be set about a foot apart in the row. Many nurserymen prefer to use a thin spade for transplanting, running this into the ground, bending it over, and setting in the tree. In this operation one man uses the spade while another man inserts the tree. When the spade is withdrawn, each man presses a foot near the tree and firms the soil tightly about it. In other cases the nurseryman prefers to simply run a furrow or double furrow down the row, set the tree firmly into position by hand, and then fill in the soil with a plow.

In setting the seedlings they should be placed so that the level of the soil is approximately at the same height on the seedling as when it grew in the seed bed. If the trees happen to be set an inch or so lower it will be of no serious disadvantage. In this work of transplanting, all small and inferior seedlings should be thrown out, as in all probability they will make only second or third rate nursery stock and will prove to be poor trees in the grove. What is wanted of nursery stock is a tree that has vigorous growth.

CULTIVATION OF THE NURSERY.

The cultivation of the nursery may begin immediately after the seedlings are set out. The cultivation at first need not be deep, merely running over with the finishing tools to conserve the moisture and keep the ground in good condition. Where the soil is sandy the cultivation at no time need be much more than this. In the heavy clay soils it is important to break up the soil as deeply and thoroughly as possible. The length of time elapsing between repetitions of cultivation will depend upon the condition of the soil. In all of the work of cultivating citrus trees it should be remembered that the destruction of weeds is of secondary importance. Of course this should never be neglected, but the real value of cultivating lies in the fact that the soil is kept in a suitable condition of aeration. If a heavy, beating rain falls immediately after cultivating, much of the good effected by the work is lost, and consequently another cultivation should be made as soon as the soil conditions will permit.

SEEDLING GROVE.

In the early history of the citrus industry main reliance was placed on the propagation of trees from seed. Such trees, when grown to fruiting age, are usually spoken of as seedlings. The use of seedling groves has been almost entirely superseded by budded groves. At the present time very few seedling groves are being planted. If one wishes to plant a seedling grove it is of the utmost importance to make a careful selection of the tree from which the seeds are taken. The parent tree should be a uniformly heavy cropper and one that produces superior fruits of the kind desired. Even with all of these precautions there is less certainty as to the quality and quantity of fruit that will be produced than where budded trees are planted.

Another disadvantage of planting seedling groves is that such trees are later in coming into bearing than budded trees and as a rule are of a more upright growth. The vigor of seedling trees is usually greater than that of the ordinary budded grove, but this is practically the only strong argument in favor of a seedling grove.

PROPAGATING BY CUTTINGS.

Lemons, limes, pomelos, and other citrus species may be propagated very readily from cuttings. The cuttings should be made from fairly matured wood and at such time of the year as will give considerable moisture to the soil and at the same time considerable

warmth. While these cuttings have been employed for producing nursery stock on which to bud they are not so satisfactory as seedlings. The growth is somewhat slower and not as straight. Root cuttings from these various species may also be employed, but these have the same disadvantages that are encountered with the use of cuttings from the branch.

BUDDING.

There are various methods of propagating citrus trees—by budding, grafting, or inarching. While there are conditions under which grafting becomes necessary and when inarching must be practiced to obtain the desired end, budding is preeminently the best method of propagating citrus trees. The work is done so easily and may be accomplished with such certainty of good results that grafting and inarching as methods of increasing the stock of any particular variety must be considered obsolete.

The subject of budding was well covered by Dr. H. J. Webber in his paper entitled "Methods of Propagating the Orange and Other Citrus Fruits," which appeared in the Yearbook of the United States Department of Agriculture for 1896, and as no important improvements have been made since that date the following chapters, with the exceptions of those on time of budding and on cutting buds, are quoted without modification.

TIME OF BUDDING.

In regions where a more or less definite winter occurs, budding is practiced either late in the autumn, about November or December, and called dormant budding; or in the spring, after a vigorous growth has started. Good citrus stock may be budded at almost any time of the year, except during the winter in those sections where a decided lowering of the temperature occurs. In general it may be said that buds may be inserted at any time of the year when the bark of the stock separates easily from the wood. This always indicates a strong flow of sap.

CUTTING BUDS.

Some experienced nurserymen prefer to cut the bud sticks and keep these for a few days or several weeks before inserting the bud. It is thought by them that a larger percentage of the buds will take under these conditions.

SELECTING BUDS.

Bud wood should always be selected from fairly well-matured wood of the current year's growth. Round sticks (or as nearly round as possible) should be selected. The young growth of orange wood is at first angular, becoming rounder as the twig matures. The basal portions of the young branches, which are nearly or quite round (fig. 2, *a*), supply the best buds, with the exception of the first two or three, which are usually somewhat imperfect and should be

discarded. Where it is difficult to secure well-rounded wood, angular wood which is not too soft (fig. 2, *b*) may be used. This, however, is not quite so satisfactory. Thorny bud wood should never be used when other wood can be obtained. Thorny trees are very undesirable, and a careful selection of thornless bud wood will soon result in thornless trees. The thorns have been bred out of many of the best citrus varieties, and if nurserymen would exercise proper care all the desirable varieties could soon be rendered thornless.

After cutting, the leaves should be pruned off and the twigs cut into sections of the desired length. To preserve the bud wood until needed the twigs should be tied up in convenient-sized bundles, carefully labeled, and packed in old sawdust in a box of suitable size. The box should then be closed and buried in sheltered ground several inches below the surface. In this way bud wood can be preserved in good condition for from two to three months. Dampened sphagnum, or peat moss, may be used instead of sawdust, but in this case considerable care must be exercised to get the moss properly dried. It must be moist, but not wet, for if too wet the bud wood may mold. The same caution applies also to sawdust. In this case the proper degree of moisture can be secured by taking the material from the interior of an old pile. Sawdust does not lose its moisture readily and is the best material for packing. Some simply bury the bud wood in the soil under shelter, digging down until the moist earth is reached.[1]

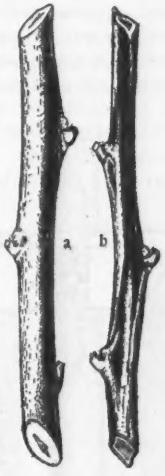

FIG. 2.—Sweet-orange twigs: *a*, Round twig of select buds; *b*, angular twig of buds. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

MATERIALS FOR BUDDING.

Before beginning the operation of budding, material should be provided for wrapping the buds. For this purpose cotton cord, yarn, strips of waxed cloth, etc., are used. The last named has practically superseded all others in Florida, being more convenient and giving better results than any other wrapping material. The strips are made from strong muslin or calico. Before the cloth is torn into strips it is folded into convenient size and dipped into a hot solution of wax made by melting together two parts of beeswax and one part of rosin. Several formulas for making this wax are used, any one of which will probably answer. The method described is known from personal experience and observation to give good results. After saturating the cloth with the hot wax, all the superfluous wax should be removed before the cloth cools. To accomplish this quickly, hang the piece of cloth, folded in convenient form before waxing, over a small, strong stick (fig. 3, *a*), which is held by an assistant. Then take two similar sticks of wood, and holding them parallel on either side of the cloth (fig. 3, *b*), press them firmly together and pull downward, squeezing out the superfluous hot wax. The cloth should then be spread out until cool, after which it is ready to be torn into strips of the desired size—that is, one-fourth to one-half inch wide and from

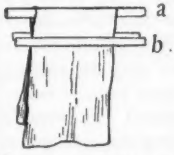

FIG. 3.—Strip of budding cloth, showing method of removing surplus wax. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

[1] The clean, long sawdust from cypress shingles will make an excellent packing material.—P. H. R.

10 to 12 inches long. The cloth may be torn into strips before it is taken into the field or it may simply be torn into convenient-sized pieces and afterwards torn into strips in the field as desired for use. The latter is probably the most convenient way.[1]

Using waxed cloth for wrapping effectually excludes moisture, prevents the bud from drying out, and the work can be done more quickly than with string, as the strips cover more surface and do not require tying, the wax serving to hold the cloth firmly in place. It may therefore be recommended as far preferable to any other wrapping material.[2]

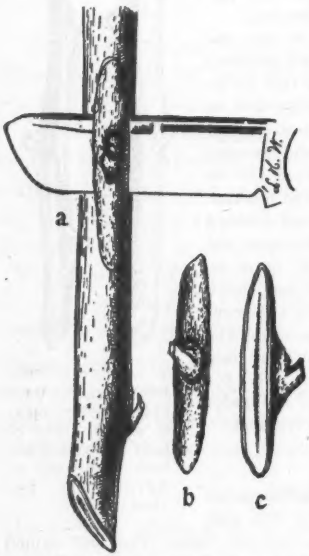

FIG. 4.—Shield or eye buds: *a*, Method of cutting bud from round twig; *b*, bud cut ready to insert; *c*, face of bud showing the cut surface. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

HOW TO BUD.

Budding is a simple process, consisting in inserting a bud of a desired variety under the bark of the stock in such a way that the freshly cut inner bark of the bud comes in close contact with the layer of growing wood (cambium) of the stock. The bark is closed over the inserted bud and the stock wrapped with waxed cloth, as described, so that the bud is firmly pressed against the growing wood. If the operation is properly performed, the tissue of the bud and stock soon fuse together and the bud may be forced to grow.

In all varieties and stocks of citrus fruits the process of budding is practically the same, the method commonly employed being that known as shield or eye budding (fig. 4). The bud is inserted in the young stock near the ground. Previous to the severe freezes of the winter of 1894–95 the general practice was to insert the buds 12 to 18 inches above the ground, but since then the tendency is to bud as near the surface of the soil as possible, so that the trees may be readily banked with the earth above the bud to protect against injury from freezes. Most of the buds are now inserted from 2 to 6 inches above the soil. In sections where foot-rot is abundant and sour-orange stock is used as a preventive measure the buds should be inserted from 12 to 18 inches above the soil, so that the sweet-orange wood will be above the influence of the disease.

All leaves and limbs which would hinder the proper wrapping of the buds should be cut away with a sharp budding knife. The use of sharp tools is the secret of success. A vertical cut about 1½ inches long is made at the point where

[1] The waxed cloth may be torn in strips half an inch wide and the length of the cloth and wrapped into balls. In wrapping the balls each new piece added is slipped about half an inch under the former piece. These balls make a very convenient method of carrying the waxed cloth into the field.—P. H. R.

[2] The choice of wrapping material is an individual and a local affair. Some nurserymen use only raffia and have nearly perfect success; other nurserymen use only cotton wrapping twine and their buds take almost perfectly. They are located in the moister sections, where buds are not likely to dry out.—P. H. R.

the bud is to be inserted. At the base of this a horizontal cut is made, so that the two cuts present the appearance of an inverted T (⊥), as shown in fig. 5, *a*. The cuts should not be deep. The aim should be to merely cut through the bark, but no injury will result if the cuts are rather deeper. The lower edges of the bark are slightly raised with the end of the knife blade (fig. 5, *b*) to facilitate the insertion of the bud. This may also be accomplished by giving the knife an upward turn after making the horizontal cut. Now, take a stick of bud wood in the left hand and cut out a bud, as illustrated in fig. 4. Formerly the portion of the wood cut out with the bud was removed, but experience has shown that this is entirely unnecessary. The upper end of the bud is inserted under the slightly raised ends of the bark (fig. 5, *c*) and gradually pushed upward until all portions of the cut face of the bud come in contact with the wood of the stock (fig. 5, *d*). If in proper condition for budding, the bark of the stock readily separates, allowing the bud to be pushed

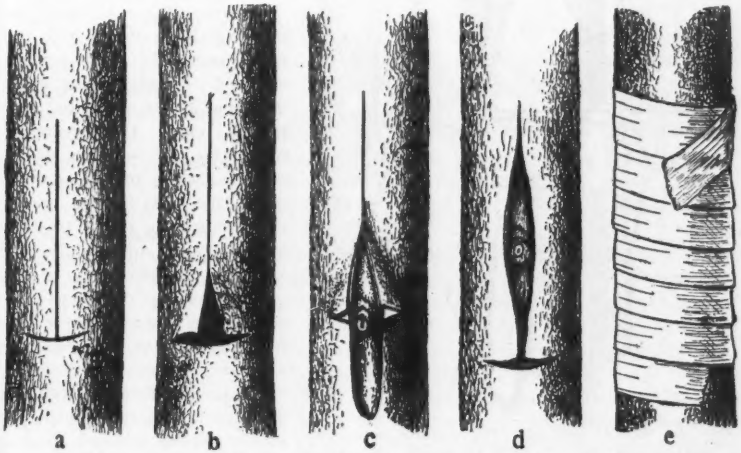

FIG. 5.—Shield or eye budding: *a*, Incision on stock; *b*, incision with lower ends of bark raised for inserting the bud; *c*, bud partially inserted; *d*, bud inserted ready to wrap; *e*, bud wrapped with waxed cloth. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

upward into position. The bud is now ready to wrap. Take a strip of the waxed cloth prepared as above, and beginning slightly below the horizontal cut wrap tightly around the stock over the bud in a spiral manner, each turn slightly overlapping the previous one. The wax holds the cloth in place and makes it possible to draw it very tight. When the vertical incision has been entirely covered, turn the end of the strip slightly downward over the wrapped portion, to which it adheres more firmly than it would to the bark, and no tying will be necessary (fig. 5, *e*). It is better to wrap from below upward, as in this case each turn overlaps the other in the right direction to prevent water running down the stem from entering. Nurserymen usually wrap over the bud, covering it entirely. Some, following the practice commonly used with other fruits, leave the eye of the bud exposed. This, however, is more troublesome and does not succeed so well.

In some cases where bud wood of certain varieties is difficult to secure, it may be desired to use buds from the young angular wood (fig. 2, *b*). This may

be used with good results if the stock to be budded is growing rapidly and is in a succulent condition. In this case the method of cutting and inserting the bud is slightly different from that already described. In cutting the buds the stick is turned slightly to one side, so that as the bud is cut off the eye lies on one side instead of in the center of the bud (fig. 6, *a*, *b*, and *c*). It is only by cutting the bud in this way that the cut surface is made wide enough to hold the bud firmly in position. For inserting these buds an incision is made in the bark, as shown in fig. 5, *a*. The bark is slightly raised on one side with the point of the knife and the bud is slipped under in a lateral direction, the eye remaining in the vertical slit (fig. 6, *d*). The bud is then wrapped as shown in fig. 5, *c*.

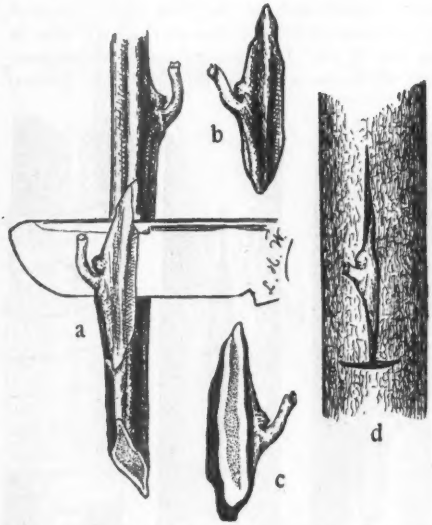

FIG. 6.—Shield budding with angular wood: *a*, Cutting the bud; *b*, bud cut ready to insert; *c*, bud showing cut face; *d*, bud inserted, bark on right side only being raised. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

UNWRAPPING THE BUDS.

In from 10 to 12 days the buds will have united with the stock and may then be unwrapped. In early spring, when the weather is cool and the growth slow, the wrapping should be left on from 15 to 20 days, while in the summer when the weather is warm and the growth rapid, 10 days is usually a sufficient length of time. However, it is impossible to say definitely how much time should elapse before the wrapping should be removed, as the wood of the stock should never be allowed to grow over the buds. It should not be removed until a light grayish line of new tissue can be seen forming around the edge of the incision made in inserting the bud. A little experience will enable one to tell at what stage it is safe to unwrap. Under ordinary conditions from 12 to 15 days will give good results, but in very dry weather in the summer, when growth is slow, it may be necessary to leave the wrapping on for a longer time. Some 10 days after budding an examination should be made of a number of the buds, and if they are found to be well healed on, the wrapping may be taken off; but if not, the wrapping should be replaced and allowed to remain some time longer. If the wraps are allowed to remain too long, the wood of the stock is likely to grow over the buds and greatly hinder their pushing.

FORCING THE BUDS.

In order to force the buds to push uniformly after they have healed on, it is necessary to severely check the growth of the stock. This is most commonly accomplished in nursery trees by lopping the tops, as it is called, which is usually done from 3 to 5 days after the wraps are removed from the buds. The lopping is usually done with pruning scissors, the knife edge being placed

about 2 inches above the bud and the stock cut two-thirds through. The top is then bent over to one side and allowed to rest on the ground (fig. 7, *a*).

To provide for subsequent cultivation and attention it is necessary to use some definite plan of budding and lopping in the nursery. Two methods most commonly followed by Florida nurserymen are to lop the tops of two adjoining rows into the same center (fig. 8, *a*), keeping the alternate centers free for cultivation, or to lop the tops of alternate rows in different directions, one row in each center (fig. 8, *b*), and place them near the rows. By the latter method a cultivator may be run up one row and down the other, passing always in the direction in which the tops are inclined so that the branches will not interfere with the cultivator. Usually the old tops are allowed to remain attached until the buds have attained a height of from 12 to 18 inches, after which they may be cut off.

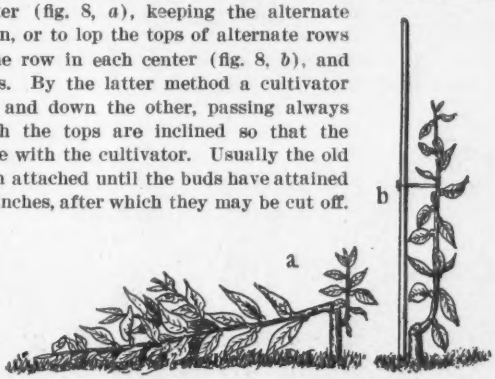

FIG. 7.—Treatment of buds: *a*, Young tree lopped to force bud; *b*, bud and supporting stake after "lop" has been removed. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

Some nurserymen have found that the buds make a larger growth if the old tops are allowed to remain attached through the summer and are cut off in September. If this practice is followed, two rows of trees should be lopped together. The tops thus form a dense shade or sort of mulch on the soil, keeping it moist and preventing the weeds from growing. In this case it is also desirable that the rows lopped together should be planted rather close (about 3 feet apart), for if this is not done the weeds will grow up among the tops, making it necessary to cut off the latter when the buds are 1 foot to 18 inches high in order to keep the weeds down. In the case of vigorously growing stocks, like the rough lemon, it is said to be very desirable to leave the tops attached for some time.

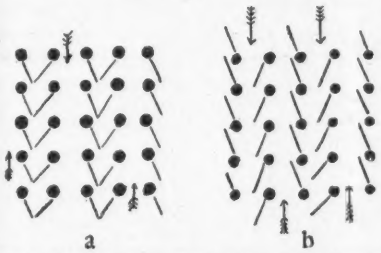

FIG. 8.—Diagrams illustrating methods of lopping nursery trees: *a*, Lopping two rows in one center, leaving alternate centers free for cultivation; *b*, lopping alternate rows in opposite directions. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

When the old tops are removed, the portion remaining above the bud should be cut off smooth and close to the bud, so that it will soon heal over without forming an ugly scar (fig. 7, *b*). Some follow the practice of coating the freshly cut end with shellac, but others working on an extensive scale never do this. It is seldom that any noticeable benefit is derived from the practice.

GROWTH OF THE BUDS.

The attachment of the rapidly growing bud is at first very weak and it is necessary to strengthen it by tying to a stake (fig. 7, *b*). Some nurserymen practice cutting the stock rather high in lopping, and support the buds for a

time by tying them to the remaining portion of the stock. The buds push much better, however, when the stocks are cut very close in lopping, so that it is hardly desirable to depend upon this method of supporting the buds, as in either case it is necessary later to supply the supporting stakes. (See figs. 7 and 9.)

The development of the buds should be carefully watched during summer, and they should be pruned in such a way as to produce a top of the desired shape. In Florida, where a low tree is desired, it is necessary to nip the tops when they are 2 or 3 feet high to induce branching. The buds which push low

FIG. 9.—Arrangement of stakes in a nursery. (From Yearbook, U. S. Dept. of Agriculture, for 1896.)

down on the stock or bud should be rubbed off before they have grown to any size, as their growth detracts from the development of the bud.

DORMANT BUDDING.

Putting in buds which are intended to remain dormant during the winter, or dormant budding, as it is called, is usually done in October or November. The process is exactly the same as described above, except that the tops are allowed to remain standing until the following spring. They are lopped in the usual manner the latter part of February, or just before the spring growth starts. The advantage of dormant budding is to secure the first spring growth in the bud, which is the largest growth in the year.